REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public recording burden for this collection of information is estimated to everage.) How per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information, including the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Coerabons and Apopts, 1215 Jefferson Coera Highway, Suite 1204, Arlington, VA. 12202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, OC 10503.

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND	DATES COVERED			
	November 14, 1997		07/01/94 - 06/30/97			
4. TITLE AND SUBTITUE	5. FUNDING NUMBERS					
AASERT94 NOVEL MATERIALS AND DEVICES FROM SELF-ASSEMBLED PERIODIC STRUCTURES			F49620-94-1-0268 Hugh C. De Long, Capt.			
6. AUTHOR(S)			3484/XS			
Sanford A. Asher		61103D				
7. PERFORMING ORGANIZATION NAME	E(S) AND ADORESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER			
University of Pittsburg Department of Chemistry		AFOSP_TR G7-060A				
Pittsburgh, PA 15260		97-060A				
9. SPONSORING / MONITORING AGENC	Y HAME(S) AND ADDRESS(ES)		10. SPONSORING / MONITORING AGENCY REPORT NUMBER			
AFOSR/NENL 110 Duncan Avenue Suite Bolling AFB, DC 20332-						
11. SUPPLEMENTARY NOTES						
122. DISTRIBUTION AVAILABILITY STA	ATEMENT		12b. DISTRIBUTION CODE			
Argroved for public rele Wistribution unlimited.	nase ;					
13. ABSTRACT (Maximum 200 words)						
We request funding for one graduate student to work on a research program focused on developing new devices prepared from self-assembling submicron periodic structures. The work involves synthesis of new colloidal materials that can be used to create self-assembled submicron periodicities, which will be used to develop new devices in the fields of optics, spectroscopy and separation science. We will create these submicron periodicities by utilizing the unique self-assembling property of monodisperse charged colloids; charged colloids self-assemble in solution to form BCC or FCC crystalline arrays (periodicities). We will examine the underlying physical phenomena responsible for this self-assembly process and will optimize the experimental conditions to prepare large defect free crystals. These crystals Bragg diffract light with extremely high efficiencies and are ideal for optical filtering applications.						
The additional student funded by the AASERT program will allow us to increase our efforts in the fabrication of nonlinear optical switchable devices, and will allow us to explore the utility of our polymerized membranes containing submicron periodic arrays as new materials useful for membrane size selective particle filtering applications.						
14. SUBJECT TERMS	,		15. NUMBER OF PAGES			
	16. PRICE CODE					
17. SECURITY CLASSIFICATION 18	8. SECURITY CLASSIFICATION	19. SECURITY CLASSIF	ICATION 20. UMITATION OF ABSTRACT			
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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)

Objectives:

There has been no change in the objectives of the proposed work.

Status of Efforts:

We have made great progress in the development of novel crystalline colloidal array (CCA) devices for optical and chemical sensing applications. We have synthesized novel polymerized CCA materials (PCCA) containing chemical recognition agents that change volume in response to analytes in the surrounding medium. The PCCA diffracts light from the embedded cubic array of colloidal particles. Binding of analytes to the recognition agents causes the PCCA volume to change, which causes the wavelength of the diffracted light to change. We have created a new, highly selective and sensitive chemical sensing motif.

Accomplishments:

- 1. Invention of new chemical sensing material. We demonstrated 20 ppb sensing of Pb²⁺ and 10⁻¹² M levels for glucose and the ability of the glucose sensor to measure O₂ concentrations (see references 1-3). The sensing material diffracts light from its BCC array of colloidal particles.
- 2. Development of a theoretical understanding of the sensing phenomenology (ref 2).
- 3. Development of a fiber optic optrode sensor which utilizes the sensing PCCA materials to remotely sense analytes.
- 4. These materials can also be used for thin film 2-D display devices. The wavelength diffracted from the PCCA can be controlled by defining the concentration of analyte at various points of the PCCA film. Colored images can be created by, for example, electrochemically introducing the analytes at different points using an electrode array attached to the PCCA film.

Personnel Supported:

John Holtz, graduate student. Ph.D. July, 1997

Publications:

- 1. "Intelligent Polymerized Crystalline Colloidal Array Hydrogel Film Chemical Sensing Materials", J. H. Holtz and S. A. Asher, Nature <u>389</u>, 829-832 (1997).
- 2. "Intelligent Polymerized Crystalline Colloidal Arrays: Novel Chemical Sensor Materials", J. H. Holtz, J. S. W. Holtz, C. H. Munro, and S. A. Asher, Anal. Chem., in press (1997).
- 3. "Novel Polymerized Crystalline Colloidal Array Sensors", S. A. Asher and J. H. Holtz, U.S. Patent filed (1996).

- 4. "Optically Nonlinear Crystalline Colloidal Self Assembled Submicron Periodic Structures for Optical Limiters", S. A. Asher, S.-Y. Chang, A. Tse, L. Liu, G. Pan, Z. Wu, and P. Li, Mat. Res. Soc. Symp. Proc. Vol. 374, 305-310 (1995).
- 5. "Crystalline Colloidal Array Optical Switching Devices", S. A. Asher and G. Pan, in Nanoparticles in Solids and Solutions (J. H. Fendler and I. Dékány, eds.), NATO ASI Series Vol. 18, pp. 65-69, Kluwer Academic Publishers, Dordrect (1996).

Transitions:

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a.	Presentations:
а.	Ticscinations.

1 rescritations.				
Gettysburg College, Gettysburg, PA	September, 1994			
• University of British Columbia, Dow Lecturer, Vancouver, BC	October, 1994			
• FACSS Meeting, St. Louis, MO	October, 1994			
University of South Carolina, Columbia, SC	December, 1994			
 University of Windsor, Windsor, Ontario, Canada 	December, 1994			
Materials Research Society Optical Limiters Symposium,				
Boston, MA	December, 1994			
Pennsylvania State University, State College, PA	February, 1995			
Carnegie Mellon University, Pittsburgh, PA	February, 1995			
 Wright Patterson Air Force Base, Dayton, OH 	May, 1995			
• Pittsburgh Plate Glass, Pittsburgh, PA	June, 1995			
Hamilton College, Clinton, NY	October, 1995			
 Materials Research Society Meeting, Boston, MA (2 lectures) 	December, 1995			
 Pacifichem '95, Honolulu, Hawaii 	December, 1995			
Wayne State University, Detroit, MI	February, 1996			
NATO Advanced Research Workshop, Nanoparticles in Solids				
and Solutions, Szeged, Hungary	March, 1996			
 Clarkson University, Potsdam, NY 	March, 1996			
 Conover Lecture, Vanderbilt University, Nashville, TN 	October, 1996			
Pittsburgh Conference, Atlanta, GA	March, 1997			
Optical Society, Pittsburgh, PA	March, 1997			
 Materials Research Society Meeting, San Francisco, CA 	April, 1997			
 American Chemical Society Meeting, San Francisco, CA 	April, 1997			
• Eastman Kodak, Rochester, NY	May, 1997			

- b. We are utilizing the results of this work in our ONR research program and also a research program funded by the DARPA Hide program.
- c. The University of Pittsburgh is negotiating licensing of this technology to a number of companies.

ATTACHMENT

AUGMENTATION AWARDS FOR SCIENCE & ENGINEERING RESEARCH TRAINING (AASERT) REPORTING FORM

The Department of Defense (DoD) requires certain information to evaluate the effectiveness of the AASERT Program. By accepting this Grant which bestows the AASERT funds, the Grantee agrees to provide 1) a brief (not to exceed one page) narrative technical report of the research training activities of the AASERT-funded student(s) and 2) the information requested below. This information should be provided to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1.	G	Grantee identification data: (R&T and Grant numbers found on Page 1 of Grant)						
	a.	University of Pittsburgh						
		University Name						
	b.	F49620-94-1-0268 Grant Number		c.				
				٥.	R&T Number			
	d.	Sanford A. A	sher	e.	From: 07/01/94 AASERT Reporting Per	To: 06/30/97		
NO	TE:	Grant to which AAS	SERT award is attach	ed is r	eferred to hereafter as "			
2. (FT aw:	EGS	ital funding of the Pa S) supported by the P date.	rent Agreement and a arent Agreement dur	the nu ring the	mber of full-time equivaled 12-month period prior	lent graduate students to the AASERT		
	a.	Funding:	\$ 146,687					
	b.	Number FTEGS:	2					
3. Agr	To eem	tal funding of the Par nent during the currer	ent Agreement and t	the nur g perio	nber of FTEGS supporte d.	ed by the Parent		
	a.	Funding:	\$ 155,146					
	b.	Number FTEGS	2					
4. by A	Tot AAS	tal AASERT funding a ERT funds during the	and the number of FT current 12-month re	TEGS a eportin	nd undergraduate stude g period.	nts (UGS) supported		
	а.	Funding:	119,025					
	b.	Number FTEGS:	2					
	c.	Number UGS:	0					
<u>VER</u> U.S.	IFIC Cit	ATION STATEMENT	: I hereby verify that	t all stu	dents supported by the	AASERT award are		
	/ 2	Investigator		_	November 14, 199	7		
Princ	ipal	Investigator		Ī	Date			